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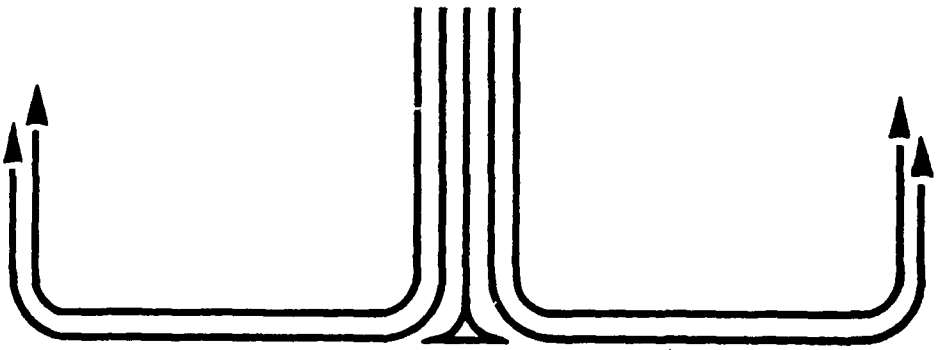
STUDENT REPORT

COMPLETION RATES AT THE SQUADRON OFFICER SCHOOL PROJECT X FACILITY

CAPTAIN ROBBIN R. SCHELLHOUS 88-2340

"insights into tomorrow"



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REPORT NUMBER 88-2340

TITLE COMPLETION RATES AT THE SQUADRON OFFICER SCHOOL PROJECT X FACILITY

AUTHOR(S) CAPTAIN ROBBIN R. SCHELLHOUS, USAF

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Submitted to the faculty in partial fulfillment of requirements for graduation.

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The original Project X facility, or Leaders' Reaction Course, was constructed at Maxwell AFB, Alabama, in 1951 as part of the Squadron Officer School (SOS) leadership curriculum. Project X currently consists of 18 different practical, "hands-on" problems designed to challenge the leadership and problem-solving abilities of groups of six officers. SOS students attend Project X twice during each 8½-week class. Between their two sessions at Project X, students receive classroom instruction in leadership, followership, problem-solving, and team building skills. This study compares the overall completion rates between the two sessions at Project X for 15 SOS classes. The study concludes that there appears to be a significant difference in completion rates between the first and second sessions, but this difference does not appear to depend on the elapsed time in days between the two sessions.

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PREFACE

The Project X, or Leaders' Reaction Course, facility has been an important part of the Squadron Officer School (SOS) curriculum since the school's beginning in 1950. SOS uses Project X as one means of providing hands-on training and practice for skills taught and discussed in the classroom. SOS students attend Project X at the beginning of the 8-1/2 week course and then again later in the course. In between sessions, students receive intensive instruction in leadership, followership, problem-solving, and team-building skills. One would expect to see an improvement in these skills, as measured by a higher successful completion rate, from the first session to the second session.

The purpose of this research is to use existing completion data from 15 SOS classes to determine if any significant difference exists between completion rates for the first and second sessions at Project X. The author hypothesizes that there is a significant difference between completion rates, and this difference is based on the elapsed time in days between the two sessions.

The author extends his appreciation to Major Michael M. Lenhart, USA, the advisor for this project, for his support, encouragement, and patience. The author also acknowledges the many SOS faculty members who helped in locating, collecting, recording, and reporting the data for this project.

ABOUT THE AUTHOR

Captain Robbin R. Schellhous graduated from the University of California-Riverside in 1965 with a Bachelor of Arts Degree in Biology and Physical Education, then continued on to Graduate School and received a California State Secondary Teaching Credential in 1970. Captain Schellhous enlisted in the Air Force in 1972, received a Bachelor of Science Degree in Civil Engineering from Texas A&M University in 1976 through the Airman Education and Commissioning Program, and was commissioned through Officer Training School in December 1976.

Captain Schellhous was then assigned to Keesler AFB, Mississippi, and served as a design engineer, as Assistant Chief of the Contract Management Branch, and as Chief of the Readiness and Logistics Section in the 3380th Civil Engineering Squadron. He then served a 13-month remote tour at Clear AFS, Alaska, as the Site Engineer. He returned to Wright-Patterson AFB, Ohio, where he received a Master of Science Degree in Engineering Management at the Air Force Institute of Technology. He was assigned to Mather AFB, California, in 1982 where he served as Chief, Resources and Requirements in the 323d Civil Engineering Squadron.

Captain Schellhous was assigned to Maxwell AFB, Alabama, in 1984 where he served as a Section Commander at Squadron Officer School for 15 classes until December 1987. He is currently a student in the Air Command and Staff College Class of 1988.

Captain Schellhous is a Distinguished Graduate of Squadron Officer School and has completed the Air Command and Staff College Seminar Program.

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EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DoD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER 88-2340

AUTHOR(S) CAPTAIN ROBBIN R. SCHELLHOUS, USAF

TITLE COMPLETION RATES AT THE SQUADRON OFFICER SCHOOL PROJECT X FACILITY

I. Problem: Squadron Officer School (SOS) has used Project X as a leadership laboratory since the school's beginning in 1950. SOS classes attend Project X early in the 8-1/2 week course and then again later in the course. The classroom curriculum in between includes instruction in leadership and team building skills. One would expect, therefore, that students would perform better the second time they attend Project X as they apply the skills of the classroom to a practical problem situation. Although SOS has maintained completion records for Project X for several years, the data has never been used to empirically support Project X as an effective tool for demonstrating leadership and team-building skill improvement.

II. Purpose: The purpose of this research is to compare the completion rates of the first and second sessions at the SOS Project X facility and determine if a significant difference exists.

III. Data: This research collected and consolidated completion statistics for SOS Classes 85-B through 88-A and calculated an overall class completion rate for each of the two sessions at Project X. Key assumptions concerning the data included genuine effort on the part of the students solving the problems, accurate and honest completion results, and adherence to the rules when

attempting each task. The study was limited to data only from the SOS Project X facility, and the study did not compare individual task completion rates. The data was analyzed using the Student's t-test, a common statistical tool for comparing the means of small (less than 30) samples. Appropriate t statistic values were calculated and compared with standard t distribution table values at the .05 level of significance. The t statistic was used to compare the completion rates of the A and B versions of the Project X tasks, the completion rates of the first and second sessions, and the completion rates of classes with different numbers of elapsed days between sessions.

IV. Conclusions: Within the assumptions and limitations of the data, this study led to several conclusions. First, it appears there is no significant difference in overall completion rates between the A and B versions of Project X tasks. Second, it appears there is a significant difference in completion rates for the first and second sessions. Finally, the research concluded that the difference in the first and second session completion rates does not appear to depend on the elapsed time between sessions. The difference in improvement for groups who attend Project X sessions two weeks apart and those who attend six weeks apart is not significant.

V. Recommendations: SOS should consider developing a computer program to better track Project X results. SOS should continue to maintain the A and B versions of each task to allow for variety, scheduling flexibility, and contingencies. SOS curriculum and scheduling personnel should not be overly concerned with where the two Project X sessions occur in the SOS curriculum. Finally, those responsible for the operation of Project X and of other similar Leaders' Reaction Courses throughout the United States may benefit from a mutual exchange of ideas, suggestions, and recommendations.

Chapter One

INTRODUCTION

THE PROBLEM

The Project X, or Leaders' Reaction Course (LRC), facility has been a part of the Squadron Officer School (SOS) curriculum since the school's beginning in the early 1950s. Since that time, other Air Force, Army, and Marine Corps training courses have developed Leaders' Reaction Courses patterned after the SOS original (11:68). Training curricula generally use these LRCs to help achieve the similar objectives of identifying, assessing, and practicing leadership and problem-solving skills in a "hands-on" practical situation. Subjective feedback seems to favor the conclusion that the LRCs do in fact accomplish, to varying degrees, their objectives. However, little if any research exists which empirically demonstrates the effectiveness of an LRC in achieving its stated objectives.

This research effort is an attempt to use the completion records maintained at the SOS Project X facility over the past three years to provide empirical support for whether or not the facility shows what one would expect it to show. SOS classes attend Project X at the beginning of the 8 1/2-week course and then again later in the course. The curriculum in between contains an intense dose of leadership and team building activities. The availability of heretofore unused completion data, coupled with the SOS "before and after" approach, lead to the research hypothesis for this project.

RESEARCH HYPOTHESIS

The purpose of this research is to compare the completion rates of the first and second sessions at Project X and determine whether a significant difference does exist. To best use the "null hypothesis" approach to data analysis, the problem is stated in the form of the following research hypothesis:

> Based on the elapsed time between sessions, there is a significant difference between overall task completion rates for the first and second sessions at Project X for SOS students.

RESEARCH OBJECTIVES

To support this hypothesis, this research will focus on four research objectives:

1. Establish background and describe the current operation of the SOS Project X facility.

2. Compare first and second session completion rates relative to task variation.

3. Compare first and second session completion rates relative to elapsed time between sessions.

4. Develop recommendations for Project X operation relative to task variation and to elapsed time between sessions.

METHODOLOGY

The methodology for supporting this research hypothesis will include a brief look at the historical background of Project X and a brief description of other LRCs in the United States. Telephone interviews with training personnel responsible for LRC operations will provide sources for those descriptions. Data on completion rates will come from SOS Project X records, which exist in several non-uniform formats dating back to 1977. Completion rates will be analyzed using the standard "Student's t-test".

LIMITATIONS

This project is directed towards that research which directly supports the stated hypothesis. Therefore, the following limitations apply:

1. This project will not attempt to compare LRCs at different locations in terms of structure, tasks, difficulty, or results.

2. This research will use only completion data from the Project X facility used by Squadron Officer School at Maxwell AFB, Alabama.

3. Analysis will not include a comparison of individual tasks at Project X in terms of relative difficulty.

ASSUMPTIONS

Use of the completion data in this research is contingent on several significant assumptions:

1. SOS students give their best effort to complete each task.

2. Students follow the rules for each task, and faculty observers accurately and uniformly enforce these rules.

3. When recorded, section results are honest and accurate.

4. Results include data equally from different times of the year. Therefore, weather conditions are not a factor in data analysis.

5. Students learn leadership and team building traits, principles, and concepts in the classroom which they can directly apply when attempting to solve Project X tasks. Successful completion of Project X tasks is directly related to an SOS section's leadership and team building development. The longer a team (section) stays together, the greater their leadership and team building development should be. One measure of this development is the number of successfully completed tasks at Project X.

Chapter Two

BACKGROUND

HISTORY OF PROJECT X

Great Britain

The present Project X concept originated in the pre-World War II years as part of a 3-day series of practical tests administered to candidates applying for admission to the Royal Military Academy at Sandhurst, England. The selection process was monitored by the Royal Army Commissions Board and consisted of academic tests, physical evaluations, and physical and mental practical exercises. Applicants had to pass the academic and physical requirements to even be eligible to begin the 3-day practical evaluations. Successful completion of these practical tests was the final factor in determining admission to Sandhurst (11:68).

> The tests were to last three days, during which time the applicant was submitted to physical and mental exercises designed to bring forth his leadership potential, ability to think fast, judgment, logic, oral expressions, written expression, stamina, physical coordination, agility, ability to analyze a problem and to form a solution in a logical manner, explain it in clear and concise terms, and direct its progress toward a final and satisfactory conclusion (12:2-5 - 2-6).

The tests were conducted at Knepp Castle, a country estate in the wooded countryside of South England. Tests conducted inside the castle included 5-minute talks, group discussions on controversial subjects, and extremely difficult individual logic problems (12:2-6). For the outdoor phase of the tests, applicants were divided into six-man groups, intentionally mixed so as to contain a wide range of personalities and comparative physical and mental capabilities. The group then proceeded to attempt to complete a series of 12 different problems, each problem physically separated from the others in the woods surrounding Knepp Castle. Upon arrival at the problem site, a Rating Officer read the problem to the group. The group then had several minutes in which to ask questions before beginning the task. A typical problem read like this:

> Gentlemen, you have just landed by parachute in this area. Your leader has been killed in the jump. Your mission is to destroy an experimental laboratory on the other side of this fence. The sentry has just passed and will not return until 40 minutes from now. You are to cross this double fence before the guard returns. Use the equipment which has been placed near the fence by partisans for your use. You must take the 30-pound bag of nitroglycerin across with you. Caution! - It must be handled very carefully. All of the members of your team must also cross. All the equipment must be taken with you as you will require it to get back across the fence. You must not touch any part of the fence with anything. It is wired so that it will set off an alarm should you touch it. The area between the fences is heavily mined and cannot be touched with any of the equipment or any part of a team member's body. Now, is this all clear? You have two minutes for questions (12:2-7 - 2-8).

The Rating Officer then observed the group's performance, made individual notes and called and enforced fouls. After the time limit expired, the group replaced their equipment then moved to the next problem. Although each task was physically different, all shared similar basic objectives: move the team from the starting point across some obstacle to "safety", operating under various equipment, movement, area, communications, and time constraints. Successful task completion was directly related to those very abilities the Royal Army Admissions Board was attempting to assess in each applicant: leadership potential, judgment, logic, physical agility, and problem solving ability. Success was also contingent upon how well the group used individual members' abilities to work together as a effective team to solve the problem (12:2-10).

It is from these 12 practical problems located outside Knepp Castle in South England that the Project X facility at Squadron Officer School at Maxwell AFB, Alabama, later developed.

Germany

Limited evidence indicates the Germans also used a similar practical test approach to selecting students for their German Military Academy in the early 1930s as they began their pre-World War II officer buildup (11:68; 10:i). However, because of the more direct connection between the British facility at Knepp Castle and its later development in the United States, the German experience is mentioned here only as a matter of interest.

United States

The development of Project X in the United States is the

direct result of the persistent efforts of Colonel Russell V. Ritchey, the first Commandant of Squadron Officer School. A brief look at Colonel Ritchey's military career will provide a better understanding of the history of Project X in the United States and more specifically at Squadron Officer School.

Colonel Russell V. Ritchey. Russell V. Ritchey was born in Indiana in 1910, joined the Indiana National Guard in 1926, entered the Army Air Corps in 1940, and served during World War II in the IV and VIII Fighter Commands. Following World War II, he was assigned in June 1946 as Chief of the Military Management Division of the Air Command and Staff School, Air University, Maxwell AFB, Alabama. Experience at the Air Command and Staff School, coupled with his experiences in World War II, created for Ritchey a special interest in leadership identification (4:3). Ritchey was especially concerned with the number of officers released from active duty because they were unqualified to hold a commission. Part of his duties during the war and later at the Air Command and Staff School involved the disposition of these unqualified officers. ". . . during the course of the war when officers were released for one reason or another, . . . it fell to my office to dispose of them. A great many of these failures were due to weaknesses which a severe pre-commissioned [sic] performance test would have discovered" (12:2-5).

Colonel Ritchey's keen interest in leadership continued in his next assignment in 1948 where he served, at the request of the Royal Air Force, as the USAF Instructor at the Royal Air Force Staff College in Great Britain. Through the US Army member of the RAF Staff College, Colonel Bethel, Ritchey learned of the Royal Army Commissions Board 3-day practical exercises. Excited by this opportunity, ". . . I found myself in 1949 at Knepp Castle in the South of England, sitting as as honorary member of the Royal Army Selection Board" (11:67). He was suitably impressed with the entire selection process and especially with the 12 practical exercises.

> The experience at Knepp Castle was of great interest and identified a field of military concern which had never, to my knowledge, been thoroughly examined in the United States. The British, in effect, had established an hypothesis that potential leaders can be identified or, in contra-distinction [sic], that men lacking the potential for leadership can be identified, or both. This hypothesis could be confirmed, they reasoned, on the basis of evidence developed from behavior patterns in their problems (12:2-5).

Colonel Ritchey's opportunity to use his RAF experience began with his reassignment to Air University in 1950. After helping to disband the Military Management School at Craig AFB, Alabama, he became Commandant of the Air Tactical School at Tyndall AFB,

Florida, with orders to deactivate the school. During this deactivation process, Colonel Ritchey received orders to ". . . plan the organization, theme of instruction, curriculum, and instruction outlines of a course designed for junior officers" (11:3). As a result of his efforts, the Squadron Officer Course (SOC) opened with Class 50-A in October 1950 at Maxwell AFB under Colonel Ritchey's command. SOC was redesignated Squadron Officer School (SOS) in November 1954.

Squadron Officer School. As is still true today, one of the key areas of interest in the early SOS curriculum was leadership assessment, training, and practice. Colonel Ritchey and the original SOS faculty quickly realized ". . . that the instructor's evaluation of a student's leadership performance under standard classroom conditions was not adequate" (5:25). The faculty needed some type of practical activity from which to make leadership assessments and to provide students the opportunity to practice the leadership and group dynamics concepts they had learned in the classroom.

Therefore, at the beginning of the second SOS class in January 1951, Colonel Ritchey outlined his RAF experience at Knepp Castle to SOS faculty members, and the idea for a similar leadership identification project as an official part of the SOS curriculum was born. Ritchey's original thoughts were to use the project to ". . . verify our academic evaluations of the students, and at the same time, improve our own understanding of leadership principles and practices" (12:3-3). Initially, Ritchey did not even have full support from the majority of the SOS faculty. This was not unexpected, as Ritchey later recalled, "This was only natural, for the entire idea was foreign to anything they had experienced in their service and few were convinced that any good would come from the program" (12:3-4). Although support was lacking at the operating level, Ritchey solicited and received wholehearted support from General Samford, Commandant of the Air Command and Staff College, and from Major General John F. Barker, Deputy Commander of Air University (3:3-4).

The next challenge to establishing a leadership identification project was to obtain detailed plans, descriptions, and solutions for each of the problems. Colonel Ritchey wrote to the War Office Ministry in London, unsure of whether they would even be willing to share their information with the United States. Within a week, however, he received a complete set of plans and drawings for each of the 12 Knepp Castle problems. The British enthusiastic support for the US project ". . . was attested to by the fact that six months later they asked us to return their drawings, for they had sent us the only copies in the whole of England!" (12:3-4).

From the British plans, SOS faculty volunteers developed basic scale models of nine problems they felt would be sufficiently challenging to USAF students. Many of the original problems needed modification in order to make them solvable, or in some cases, to make them more difficult. In modifying the original problems and in creating three new problems, Ritchey and the faculty developed a set of eight criteria against which all problems were measured and had to meet before they were considered further. These criteria were (12:3-4 - 3-5)

1. The problem should have some association with reality.

2. The problem should fit into a general theme.

3. The problem must provide full-time work for six men.

4. The problem must require all of the team to work together.

5. The problem should provide apparently obvious solutions which lead to dead-ends.

6. The problem must be solvable.

7. The problem must be solvable within a reasonable period of time.

8. The problem should not normally be solvable by less than four men.

Once the problem met each of these criteria, it was stated in written form, prepared as a drawing, then made into an actual scale model that was photographed. A team of SOS instructors totally unfamiliar with the project would then try to solve each problem first from the written statement, then from the drawing, then from the photograph, and finally by using the model. If they solved the problem before they got to the model, the problem was reevaluated in terms of making it more difficult, the concept being ". . . any problem which could be as easily solved in theory as in practice was too simple" (12:3-6).

So, after much modification and "fine tuning", Colonel Ritchey and the SOS faculty agreed on the 12 original Project X tasks. The name "Project X" originated with Colonel Ritchey during this planning and modification phase, and the name has remained to this day. Ritchey recalled, "I had named these problems Project X before they were built to keep them from being a source of curiosity until we could solve them and write the rules of procedure" (11:68).

Following final approval by Major General Barker in the late spring of 1951, Project X was constructed by 13 men in 35 days at a cost of approximately $3000.00 The original Project X was 180 feet long, 60 feet wide, and was divided into 12 separate compartments (12:3-7). Project X was expanded from 12 to 18 problems in 1970, with each new task subjected to the same criteria and testing as had the original tasks in 1951. Additionally, each of the 18 tasks was further modified into an "A" and a "B" version, the variations differing mainly in the directin of travel, in the use of equipment, and in the penalties. The different versions were designed to be of roughly equal difficulty, provide more scheduling flexibility, and lessen the likelihood of students using "intel" from previous classes to solve the problems. Each task variation was designed for a 6-person team to solve within a 15-minute time limit (15:--).

EXISTING PROJECT X FACILITIES

In addition to the Project X facility used by Squadron Officer School at Maxwell AFB, several other military training schools also have similar facilities, all operated with the same basic purpose of identifying, developing, and practicing leadership and group problem-solving skills. A basic description of major existing Leaders' Reaction Courses follows.

US Air Force

Officer Training School, Lackland AFB, Texas. 16 tasks, 6-person teams, 15-minute time limit. Officer Trainees attempt eight tasks early in the 12-week course, then eight more tasks near the end of the course. Primary objectives are leadership identification, problem-solving practice, and group interaction and teamwork. No completion records are kept (18:--).

US Air Force Academy, Colorado Springs, Colorado. 12 tasks, 6-person teams, 15-minute time limit. Fourth Class cadets participate in six tasks as part of their initial summer Basic Cadet Training. Primary objectives are identification of leadership potential and problem-solving ability. No completion records are kept (14:--).

US Army

US Army Infantry School, Fort Benning, Georgia. 17 tasks modified from the Air Force versions to reflect infantry situations and emphasize those leadership traits most appropriate to infantry officers. Primary objective is leadership assessment of the designated leader for each task. Students not part of the 6-person team solving the problem act as "harassers" and attempt to distract the participants by yelling and shouting. 12-minute time limit. No completion records are kept. This facility is

also used by Warrant Officer Candidate School students from Fort Rucker, Alabama (17:--).

United States Military Academy, West Point, New York. 13 tasks similar to those used at Fort Benning. 12-person teams with "harassers," 12-minute time limit. Primary objective is leadership assessment of the designated leader for each task. No completion records are kept (13:--).

US Marine Corps

Officer Candidate School, Quantico, Virginia. 12 tasks, 4-person teams. Officer Candidates attend the course twice. First session time limit is 13 minutes, and objective is to identify leadership potential. Second session time limit eight weeks later is 9 minutes, and objective is to evaluate leadership application. No completion records are kept. Facility also used by the Marine Corps NCO Leadership School and by the National FBI Academy (16:--).

CURRENT PROJECT X OPERATIONS AT SOS

Objectives

The basic objectives of Project X have remained fairly constant since its beginning in 1951. Colonel Ritchey's original objectives emphasized problem-solving practice and leadership identification (12:3-8):

> 1. The primary purpose of the project is to permit the students to practice practical problem-solving.
>
> 2. The secondary purpose is to identify the leader strengths and weaknesses of each student as a basis for self-evaluation, consequent self-improvement in his leadership ability, and to give him some practical work in leadership.

Stated objectives in the 1970s further emphasized the problem-solving value of Project X (7:2) and the applicability of problem-solving skills to everyday situations.

> So what does Project X prove? Hopefully, the value of the group method approach, emphasized so much at SOS and brought to light in a very real and practical manner. . . . Project X, after all, is a sort of metaphor to Air Force life. There are many situations in the Air Force where many people come together to surmount a difficult problem. While Project X is an artificial environment, the human dynamics. . . and the group interplay are very real. The feeling

is that if you can learn to work in a group, to contribute to the solution, then Project X will have been worth the effort (4:7).

The current objectives of Project X continue to emphasize the practical application of leadership and problem-solving skills and further add the concept of dynamic followership and group cohesion and teamwork (8:--):

> The students will apply and value situational leadership and dynamic followership to solve physical and mental exercises that facilitate group problem-solving, organization, and communication.
>
> Each student should:
>
> a. Apply the concepts of dynamic followership in physical and mental exercises.
>
> b. Apply situational leadership in physical and mental exercises which facilitate group problem-solving, organizing, and communication.
>
> c. Apply techniques to build a cohesive unit.
>
> d. Respond to the tasks by using situational leadership.
>
> e. Respond to the tasks by demonstrating active followership.

Procedures

SOS classes, each 8-1/2 weeks long, are held five times per year and are designated A through E. Classes consist of approximately 800 USAF captains and first lieutenants divided into sections of 12-13 officers each. Included in the total are approximately 30-35 International Officers who attend SOS in the A, C, and D classes each year (20:--). Every effort is made to divide sections as evenly as possible in terms of academic and athletic ability, Air Force specialty, aeronautical rating, years of service, and major command (19:--). Female USAF officers and International Officers are integrated equally into each section. Groups of eight sections form a squadron, and the school is composed of eight squadrons, designated A-Squadron through H-Squadron. Each section attends Project X twice during the course, each time attempting to solve six tasks. While six students are involved solving the task, the remainder act as student referees and safety observers. Therefore, at each session of Project X, each student individually participates in three of the six group problems. Each section has a faculty instructor, or Section Commander, who makes and records student performance observations, monitors the student referees, and

helps ensure fair and safe actions by the participants.

Through Class 86-C, students always did the "A" version of each of six tasks during their first session at Project X and the "B" version of six different tasks during their second session. This procedure was reversed in Class 86-D, with everyone doing B-tasks first and A-tasks second. Also, through Class 87-A, students' first session at Project X occured in Week 2, with the second session following in Week 8. This procedure was also changed in Class 87-B so that students now attend the first session in Week 3 and the second session in Week 5, a much shorter elapsed time between sessions (6:--).

Fairly complete records of task completions have been kept by squadron Project X representatives since Class 85-B. The use and analysis of this data are the subject of the remaining chapters of this research project.

Note: All uncited factual information in this chapter came from (11:--) and (12:--).

Chapter Three

DATA

The data for this research are shown in Table 1. This table is a summary of completion statistics reported by Unit Section Commanders to their respective Project X Committee representatives.

The reported total number of tasks attempted, as shown in Table 1, varies with each class for any of several reasons: 1) Section Commanders simply failed to track or report completion results to their squadron representative, 2) squadron representatives failed to report squadron results to the Project X Committee, 3) one or more tasks was closed for repair or was otherwise not used, 4) a session was cancelled partially or completely because of weather or scheduling problems, 5) equipment failure prevented a fair attempt at a task, or 6) injury or unsafe condition halted the task prematurely. These variations in numbers are not seen, however, as a significant factor affecting the reliability of the data.

Analysis of the data in Table 1 is the subject of Chapter 4.

Class	First Session				Days Between Sessions	Second Session			
	Version	Att	Comp	%		Version	Att	Comp	%
85-B	A	380	195	51.3	43	B	367	203	55.3
85-C	A	313	149	47.6	43	B	276	158	57.2
85-D	A	378	172	45.5	43	B	377	234	62.1
85-E	A	366	173	47.3	43	B	377	218	57.8
86-A	A	373	172	46.1	46	B	374	198	53.0
86-B	A	357	170	47.6	43	B	371	225	60.7
86-C	A	317	178	56.2	42	B	327	233	71.3
86-D	A	384	210	54.7	42	B	378	244	64.6
86-E	B	330	166	43.7	41	A	279	195	69.9
87-A	B	191	96	50.3	42	A	128	91	71.1
87-B	B	221	104	47.1	13	A	341	166	48.4
87-C	B	96	38	39.6	13	A	96	57	59.4
87-D	B	290	139	47.9	13	A	234	163	69.7
87-E	B	235	115	48.9	13	A	274	173	63.1
88-A	B	375	167	44.5	15	A	337	224	66.5

Att = total tasks attempted
Comp = total tasks completed
% = percent completed

TABLE 1 - Project X Completion Data -- Class 85-B through 88-A

Chapter Four

ANALYSIS

The purpose of this chapter is to describe the statistical method used to analyze the completion data shown in Table 1 and to apply this analysis to Research Objectives 2 and 3. Results of this analysis will provide the basis for accepting or rejecting the research hypothesis. It is not the intent of this chapter to provide a detailed mathematical explanation or justification for the statistical methods used in the analysis. Detailed treatment of these statistical methods may be found in the cited references.

STATISTICAL METHODS

Null Hypothesis

Research is often done because an investigator believes there is a relationship between given variables. This belief, or "hunch," becomes the researcher's hypothesis. The hypothesis in this project, for example, is based on the author's belief that there is a significant difference, based on elapsed time, between first and second session completion rates at Project X. Use of the "null hypothesis" relationship is a widely accepted statistical approach to testing hypotheses. Instead of testing the research hypothesis directly, however, the null hypothesis tests the hypothesis of "no difference" between variables. If there is in fact no difference between variables, then the observed difference between variables in the sample tested should be about the same, allowing for chance variation, as the true difference between variables in the total population (2:205).

In this research, the variables are the averages, or means, of the groups of completion rates being compared. Therefore, in mathematical terms, the null hypothesis used in this analysis may be stated as

$$D\bar{x} = \bar{D}\bar{x} = 0$$

where $D\bar{x} = \bar{X}_1 - \bar{X}_2$

= the observed difference between means of the two sample groups being compared, and

$$\bar{D}_{\bar{x}} = \mu_1 - \mu_2$$

= the hypothesized true difference in population means (2:205).

Accepting the null hypothesis implies that, except for chance variation, there is no significant difference between the means of the samples being compared. On the other hand, however, rejecting the null hypothesis implies that the difference between the sample means is significant, or is ". . . too great to be attributable to chance variation" (3:190). This research uses the null hypothesis relationship in analyzing the data in Table 1.

Confidence Level

In comparing the means of two groups of sample observations, differences may occur due to true differences between the groups, or differences may occur due simply to chance. The researcher may still accept the null hypothesis of "no difference" ($D_{\bar{x}} = \bar{D}_{\bar{x}} = 0$) even if there are small differences between $D_{\bar{x}}$ and $\bar{D}_{\bar{x}}$ if he is willing, with a certain degree of confidence, to attribute these differences to chance. "Confidence level" and "level of significance" are often used interchangeably to describe the degree of chance variation the researcher is willing to accept.

The acceptable confidence level chosen for this research is .02, meaning, basically, that 2 percent of the time one would attribute any observed differences to chance. Or, conversely, the researcher is 98 percent confident that any observed differences between means are not due to chance alone, and there is in fact a true difference between the means being compared. The choice of a .02 level of significance is an arbitrary choice on the part of this author, but it is not atypical of levels of significance used in comparing relatively small (less than 30) samples.

Student's t-Test

One statistical tool commonly used to compare the means of relatively small samples is the "Student's t" statistic. The small-sample approach to comparing differences in means was the subject of a 1908 article by W. S. Gosset, who published his work under the pseudonym "Student." From his research came the "Student's t-test" (2:216).

Without going into lengthy mathematical detail, the t-test makes allowances for the differences between small-sample distributions and the normal distribution. For small sample sizes (less than 30), the distribution curve is "flatter" than the normal bell-curve distribution, and a special distribution

table for the t-statistic is needed (2:217). Tables of values for t at various levels of significance and for different degrees of freedom (related to the numbers of observations in each sample) are given in statistics manuals. A portion of such a table showing values applicable to this research is reproduced in Table 2.

	Level of significance (P)					
n	.10	.05	.02	.01	.005	.001
...	.....	.....	.....	.....	.....	.....
11	1.796	2.201	2.718	3.106	3.497	4.437
12	1.782	2.179	2.681	3.055	3.428	4.318
13	1.771	2.160	2.650	3.021	3.372	4.221
14	1.761	2.145	2.624	2.977	3.326	4.140
15	1.753	2.131	2.602	2.947	3.286	4.073
...	.....	.....	.....	.....	.....	.....
28	1.701	2.048	2.467	2.763	3.047	3.674

TABLE 2 (1:Appendix I) - Values of t at Given Degrees of Freedom (n) and at Specified Levels of Significance (P)

A value for t is calculated by the researcher, and the corresponding value of P is found in the table for a given number of degrees of freedom (n). The P value from the table is compared with the researcher's acceptable level of significance, and the null hypothesis is accepted or rejected accordingly. The t statistic is calculated according to the following formula (2:217):

$$t = \frac{D\bar{x} - \bar{D}\bar{x}}{s}$$

where s = standard error of the difference in means

The null hypothesis, or the hypothesized "no difference" between population means, in this research implies $Dx = 0$. Therefore, the formula for t becomes

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s}$$

where $\bar{X}_1$ = mean of the first group of observations

$\bar{X}_2$ = mean of the second group of observations

The value of s, the standard error of the difference in means, is given by the following formula (2:221):

$$s = \sqrt{\left(\frac{\Sigma X_1^2 + \Sigma X_2^2 - (N_1 \bar{X}_1^2 + N_2 \bar{X}_2^2)}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}$$

where N_1 = number of observations in first group

N_2 = number of observations in second group

A brief hypothetical example (2:221) will illustrate and summarize the use of the t statistic:

Given: $N_1 = 7$ $N_2 = 8$

$\bar{X}_1 = 72.0$ $\bar{X}_2 = 36.0$

$s = 6.90$

$$\therefore \quad t = \frac{72.0 - 36.0}{6.90} = 5.22$$

$$n = N_1 - N_2 - 2 = 13$$

Entering Table 2 at n = 13, at a value of t = 5.22 the level of significance (P) is less than .001, or $P < .001$. But in order to accept the null hypothesis, the researcher has arbitrarily decided that P must be greater than .02, or $P > .02$. Therefore, since from the table $P < .02$, the null hypothesis is rejected, and the evidence suggests there is a significant difference between sample means.

This example illustrates the format used in the analyses that follow in this chapter. The observations used in all calculations were taken from the appropriate completion rate (%) values shown in Table 1. The "X" quantities in all calculations in this chapter represent percent values.

DATA ANALYSIS

Research Objective 2

Before determining completion rate differences based on elapsed time between sessions (Research Objective 3), it was

necessary to compare completion rates relative to task variation. Of the 15 SOS classes in the sample, 8 classes performed the A-tasks during their first Project X session, and 7 classes performed the B-tasks first.

A comparison of the mean completion rates of the 8 A-task classes with those of the 7 B-task classes for both sessions was accomplished to determine if any significant difference exists between A and B tasks. Comparisons of A vs B tasks for each session are shown in Figure 1 and Figure 2.

First Session

A-Task Completion Rates	B-Task Completion Rates
X_1 = 51.3	X_2 = 47.3
47.6	50.3
45.5	47.1
47.3	39.6
46.1	47.9
47.6	48.9
56.2	44.5
54.7	-----

$\bar{X}_1$ = 49.54 N_1 = 8	$\bar{X}_2$ = 46.00 N_2 = 7

$$s = 1.868$$

$$\therefore \quad t = \frac{49.54 - 46.00}{1.868} = 1.895$$

$$n = 8 + 7 - 2 = 13$$

From Table 2, @ t = 1.895 and n = 13, P > .05.
Since P > .02, accept the null hypothesis.

It appears there is no significant difference between A and B tasks performed during the first session.

FIGURE 1 - Comparison of A and B Tasks for the First Session at Project X

Second Session	
A-Task Completion Rates	B-Task Completion Rates
X_1 = 69.9 71.1 66.4 59.4 69.2 63.1 66.5 -----	X_2 = 55.3 57.2 60.5 57.8 52.9 60.6 72.8 64.6 -----
$\bar{X}_1$ = 66.51 N_1 = 7	$\bar{X}_2$ = 60.21 N_2 = 8

$$s = 2.795$$

$$\therefore t = \frac{66.51 - 60.21}{2.795} = 2.254$$

$$n = 7 + 8 - 2 = 13$$

From Table 2, @ t = 2.254 and n = 13, P > .02.
Since P > .02, accept the null hypothesis.

It appears there is no significant difference between A and B tasks performed during the second session.

FIGURE 2 - Comparison of A and B Tasks for the Second Session at Project X

Research Objective 3

Having determined that there appears to be no significant difference between A and B tasks, the author then compared the mean completion rate of the first session with the mean completion rate of the second session. It made no difference that the completion rates in each session were composed of both A and B tasks. Comparison of the first and second session completion rates are shown in Figure 3.

First Session Completion Rates	Second Session Completion Rates
X_1 = 51.3	X_2 = 55.3
47.6	57.2
45.5	60.5
47.3	57.8
46.1	52.9
47.6	60.6
56.2	72.8
54.7	64.6
43.7	69.9
50.3	71.1
47.1	66.4
39.6	59.4
47.9	69.2
48.9	63.1
44.5	66.5
$\bar{X}_1$ = 47.87 N_1 = 15	$\bar{X}_2$ = 63.15 N_2 = 15

$s = 1.919$

$\therefore \quad t = \frac{47.87 - 63.15}{1.919} = 7.964$

$n = 15 = 15 - 2 = 28$

From Table 2, @ t = 7.964 and n = 28, P < .001.
Since P < .02, reject the null hypothesis.

It appears there is a significant difference between first and second session completion rates.

FIGURE 3 - Comparison of First and Second Session Completion Rates at Project X

Having determined that there is a significant difference between first and second session overall completion rates, the author then compared first and second session completion rates relative to elapsed time between sessions. For 10 of the 15 SOS classes in the sample, 41 to 46 days elapsed between Project X sessions. For the other 5 classes in the sample, only 12 to 15 days elapsed. The research hypothesis implies that groups with a longer time span between sessions should show a greater

improvement in leadership, followership, and problem-solving abilities, as measured by successful task completion. Groups with only 12-15 days between sessions should also show improvement, but to a lesser degree than the 41-46 day group.

As a measure of improvement, the author calculated the difference in completion rates between the first and second sessions for each class. The means of these differences for the 12-15 day classes and the 41-46 day classes were then compared using the t statistic. This comparison is shown in Figure 4.

Completion Rates

12-15 Days Between Sessions			41-46 Days Between Sessions		
1st Session	2nd Session	Diff	1st Session	2nd Session	Diff
47.1	66.4	19.3	51.3	55.3	4.0
39.6	59.4	19.8	47.6	57.2	9.6
47.9	69.2	21.3	45.5	60.5	15.0
48.9	63.1	14.2	47.3	57.8	10.5
44.5	66.5	22.0	46.1	52.9	6.8
		-----	47.6	60.6	13.0
			56.2	72.8	16.6
			54.7	64.6	19.9
			43.7	69.9	16.6
			50.3	71.1	9.9

$\bar{X}_1 = 19.32$ $\bar{X}_2 = 13.24$

$N_1 = 5$ $s = 3.172$ $N_2 = 10$

$$\therefore t = \frac{19.32 - 13.24}{3.172} = 3.197$$

$$n = 5 + 15 - 2 = 13$$

From Table 2, @ t = 1.917 and n = 13, P > .05.
Since P > .02, accept the null hypothesis.

It appears there is no significant difference between improvement differences.

FIGURE 4 - Comparison of the Improvement Differences Between Classes With 12-15 Days and Classes With 41-46 Days Between Sessions

Chapter Five

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Several general conclusions can be made from analysis of the Project X completion data used in this research project. These conclusions are based on statistical analysis and relate to task variation, differences between sessions, and time elapsed between sessions.

Task Variation

It appears there is no significant difference between the A and B versions of the 18 tasks at Project X. Although the relative difficulty of individual task versions may vary, the average completion rates for the set of A-tasks compared to the the set of B-tasks are not significantly different. This finding is consistent with the intent of Project X planners in 1987 as they attempted to create A and B versions for each task of approximately equal difficulty.

Difference Between Sessions

The evidence also suggests there is a significant difference between first and second session completion rates. Based on the assumption that leadership and followership skills, problem-solving abilities, and team cohesion all increase as sections of officers progress through SOS, this conclusion is not surprising. Care must be taken, however, in drawing conclusions as to why improvement does occur between the first and second sessions. The qualities mentioned are certainly contributing factors, but so are other intangible factors such as individual motivation, attention span, interest, distractions, understanding, physical ability, and many others.

Therefore, the only conclusion supported by this research is simply that there does appear to be a difference in completion rates between sessions. Furthermore, within the assumptions and limitations of this study, this difference appears to be due to factors other than chance.

Also, based on the previous conclusion that there appears to be no difference in the overall completion rates of A and B

tasks, the order of task variation (A-tasks first, B-tasks second or visa versa) does not appear to be a significant factor contributing to improvement.

Research Hypothesis

The evidence does not support the research hypothesis that this difference in completion rates is based on elapsed time between sessions. Differences in improvement from first to second session are not significant when comparing classes with 12-15 days between sessions to classes with 41-46 days between sessions.

Again, care must be taken in drawing conclusions as to why this overall significant difference does not depend on elapsed time. Perhaps the first visit to Project X gives students enough of a "feel" for the problems that the amount of time until the next session does not increase their likelihood of increased success. Or perhaps students improve their leadership and followership skills, problem-solving abilities, and team cohesion as much in 12-15 days as they do in 41-46 days. Again, however, this research only suggests that, although there appears to be a significant improvement between sessions, this improvement is based on factors other than the elapsed time between sessions.

RECOMMENDATIONS

Based on this research effort and on the conclusions suggested from analysis of available Project X data, the author offers the following recommendations:

1. SOS should consider developing a computer program for tracking Project X completion data. Existing SMART Spreadsheet software available at SOS could easily be adapted for this purpose. Computer tracking could provide instant access to data and statistics this author spent many hours collecting, organizing, and using in calculations.

2. SOS should continue to maintain A and B versions of each task. Having two variations essentially increases the number of problems to 36 and allows for variety, scheduling flexibility, and contingencies. It does not matter which version is scheduled first since overall the two versions are of approximately equal difficulty.

3. SOS should not be overly concerned with where Project X sessions fit into the class schedule. As a practice ground for leadership, followership, problem-solving, and team building skills, Project X results indicate an improvement in these skills which is not significantly different for classes with two weeks or classes with six weeks between sessions.

4. SOS may consider establishing working relations with other Leaders' Reaction Course facilities throughout the United States. Such relations could encourage an exchange of ideas on operations and procedures, a comparison of individual tasks, and suggestions and recommendations for improved operations.

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